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(54) **Die for drawing sheet metal and similar**

(57) A die (1) for drawing sheet metal (2) and similar, the die having a main body (4) which may be housed inside any die holder seat (3) on a machine tool, with a top surface (4a) substantially coplanar with the work plane (P) of the sheet metal (2) to be worked; and two drawing tools (5) housed inside the main body (4) and movable between a withdrawn position, in which the

drawing tools are confined within the main body (4), and an extracted position, in which the drawing tools project outwards of the main body (4) by respective end portions of given length h; the die (1) having a lifting device (7) for selectively moving either of the two drawing tools (5) between the extracted position and the withdrawn position.

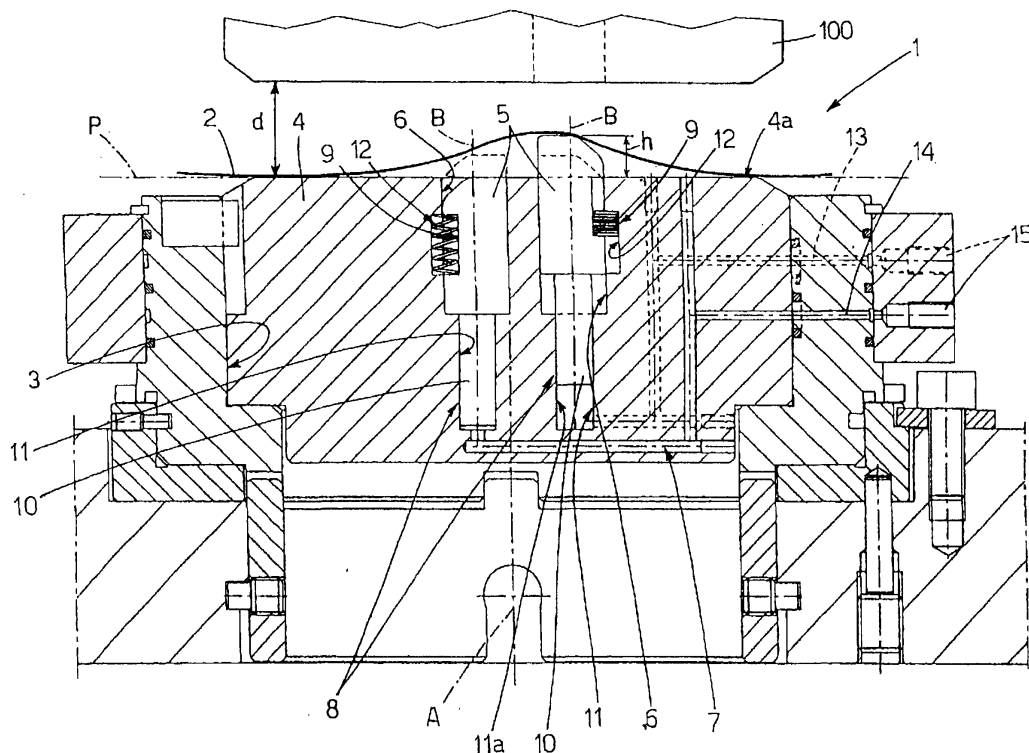


Fig.2

Description

[0001] The present invention relates to a die for drawing sheet metal and similar.

[0002] As is known, and as shown in Figures 1a and 1b, currently used dies I for drawing sheet metal and similar comprise a normally cylindrical main body II, which is insertable inside any die holder seat III on a punching machine, with a top surface IIa coplanar with the work plane P of the sheet IV to be worked; and an appropriately shaped appendix V projecting beyond work plane P from top surface IIa of main body II.

[0003] Dies of the above type are normally associated with a drawing punch VI, which is located over the work plane P, is aligned with die I, and is movable between a parking position in which the bottom end VIa of the punch is located a given distance d (normally 20 mm) from work plane P (Figure 1a), and a work position in which bottom end VIa of the punch contacts the top surface IIa of main body II (Figure 1b).

[0004] The bottom end VIa of drawing punch VI is obviously shaped to mate with the top end of die I, with sheet IV in between, so as to draw sheet IV.

[0005] To enable sheet IV to be ejected from mold I and moved easily in the work plane, the total height h of appendix V of currently used dies must be no more than half the distance d between top surface IIa of main body II, i.e. work plane P, and the bottom end VIa of drawing punch VI in the parking position.

[0006] Since increasing the travel of drawing punch VI - that is, distance d between work plane P and the bottom end VIa of drawing punch VI in the parking position - is mechanically unfeasible, currently used drawing dies I are severely handicapped by providing for only a small amount of deformation of sheet IV.

[0007] It is an object of the present invention to provide a die for drawing sheet metal and similar, designed to eliminate the aforementioned drawbacks.

[0008] According to the present invention, there is provided a die for drawing sheet metal and similar, the die comprising a main body which may be housed inside any die holder seat on a machine tool, with a top surface substantially coplanar with the work plane of the sheet metal to be worked; and at least a pair of drawing tools housed inside the main body and movable between a withdrawn position, in which the drawing tools are confined within said main body, and an extracted position, in which the drawing tools project outwards of said main body by a respective end portion of given length h; the die being characterized by comprising actuating means for selectively moving either of the two drawing tools between the extracted position and the withdrawn position.

[0009] A non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

of the present invention;

Figures 3 to 7 show sections of respective variations of the Figure 2 die.

[0010] Number 1 in Figure 2 indicates as a whole a die for drawing sheet metal 2 and similar, and which may be housed inside any die holder seat 3 of currently used punching machines, facing a corresponding known drawing punch 100.

[0011] Die 1 comprises a preferably, but not necessarily, cylindrical main body 4, which is housed inside die holder seat 3 with a top surface 4a coplanar with the work plane P of sheet 2 to be worked; and a pair of drawing tools 5 housed inside main body 4 and movable between a withdrawn position confined within main body 4, and an extracted position in which a respective end portion of given length h of drawing tools 5 project outwards of main body 4. More specifically, each drawing tool 5 is housed in axially-sliding manner inside a respective seat 6 extending from top surface 4a of main body 4 and inwards of main body 4 along an axis B preferably, but not necessarily, parallel to the longitudinal axis A of main body 4.

[0012] Die 1 also comprises a lifting device 7 for selectively moving either of the two drawing tools 5 from the withdrawn to the extracted position and vice versa.

[0013] In the example shown, lifting device 7 comprises a pair of hydraulic actuators 8 controlled to move drawing tools 5 from the withdrawn to the extracted position; and a pair of reaction springs 9 for holding drawing tools 5 in the withdrawn position.

[0014] Each hydraulic actuator 8 is located at the bottom of a respective seat 6 and, when commanded, provides for lifting drawing tool 5, which is movable inside seat 6, from the withdrawn to the extracted position; and each reaction spring 9 is housed inside a respective seat 6 and located over a respective hydraulic actuator 8, with a first end resting on main body 4, and a second end resting on drawing tool 5 to push drawing tool 5 towards the bottom of seat 6 into the withdrawn position.

[0015] With reference to Figure 2, each hydraulic actuator 8 comprises a piston 10 housed in axially-sliding manner inside a cylindrical cavity 11 extending inwards of main body 4 from the bottom of seat 6; a first end of piston 10 projects inside seat 6 and supports drawing tool 5; and a second end of piston 10 defines, together with the walls of cylindrical cavity 11, a variable volume chamber IIa filled with pressurized, obviously incompressible, oil.

[0016] Each reaction spring 9 is trapped inside a cylindrical cavity 12 formed inside seat 6, partly in the wall of main body 4 defining seat 6, and partly in the body of drawing tool 5. The two parts of cylindrical cavity 12 slide with respect to each other, and face each other when drawing tool 5 is in the withdrawn position. Being trapped between the two parts of cylindrical cavity 12, reaction spring 9 is of maximum length when the two parts of cylindrical cavity 12 are positioned facing each

Figure 2 shows a section of a die for drawing sheet metal and similar, in accordance with the teachings

other, and opposes any mutual sliding movement of the two parts of cylindrical cavity 12, and hence any movement of drawing tool 5 from the withdrawn position.

[0017] Lifting device 7 also comprises two pressurized-oil supply conduits 13 and 14, each of which extends inside main body 4 to connect a respective hydraulic actuator 8, i.e. the variable-volume chamber 11a of the actuator, to an external hydraulic control circuit 15 (shown only partly in Figure 2) for appropriately distributing pressurized oil to the two variable-volume chambers 11a to move, when commanded, either one of drawing tools 5 into the extracted position.

[0018] In the Figure 3 variation, the two pressurized-oil supply conduits 13 and 14 of lifting device 7 are replaced by a single conduit 20 for connecting the two hydraulic actuators 8, i.e. the two variable-volume chambers 11a, directly to each other.

[0019] In this variation, since the amount of oil inside the two variable-volume chambers 11a and conduit 20 is only sufficient to entirely fill conduit 20 and one variable-volume chamber 11a, lifting device 7 provides for moving the two drawing tools 5 oppositely with respect to each other between the extracted- and withdrawn positions, so that both drawing tools 5 can never be simultaneously in the extracted or withdrawn position. In this case, lifting device 7 also provides for setting both drawing tools 5 simultaneously to an intermediate parking position in which respective end portions of length $h/2$ of both drawing tools 5 project outwards of main body 4.

[0020] It should be pointed out that the two drawing tools 5 are moved by means of drawing punch 100 at the start of the drawing operation. That is, given the form of the punch, one of the two drawing tools 5 must necessarily move into the withdrawn position, and the other into the extracted position.

[0021] Lifting device 7 in the Figure 2 embodiment may obviously operate in the same way as in the Figure 3 variation, by hydraulic control circuit 15 simply distributing pressurized oil to the two variable-volume chambers 11a in such a way as to normally maintain both drawing tools 5 in the intermediate parking position, and, when commanded, to move one of drawing tools 5 into the extracted position and the other into the withdrawn position.

[0022] The Figure 4 variation differs from that in Figure 3 by both drawing tools 5 being housed in axially-sliding manner inside one seat 21, as opposed to respective seats 6.

[0023] The Figure 5 variation differs from that in Figure 4 by lifting device 7 comprising, as opposed to two hydraulic actuators 8, a lifting wedge 22, which is movable at the bottom of seat 21 between a rest position - in which lifting wedge 22 is stationary at the center of the bottom of seat 21, so that both drawing tools 5 are set to the intermediate parking position - and two work positions on either side of the rest position - in which lifting wedge 22 is inserted beneath and lifts one drawing tool 5 into the extracted position, while simultaneously

allowing the other tool to move into the withdrawn position.

[0024] In this variation, lifting device 7 also comprises a three-position linear actuator 23 for moving lifting wedge 22 horizontally along the bottom of seat 21 between the central rest position and the two lateral work positions.

[0025] To insert and move lifting wedge 22 easily beneath drawing tools 5, lifting wedge 22 is defined by a substantially triangular-section prismatic body, and is positioned with one of the three faces resting on the bottom of seat 21; and the bottom end 5a of each drawing tool 5 is defined by a flat surface inclined with respect to the longitudinal axis B of drawing tool 5 and parallel to and facing a free face of lifting wedge 22, and rests in sliding manner on a respective free face of lifting wedge 22.

[0026] The Figure 6 variation differs from that in Figure 5 by lifting wedge 22 being defined by a cylindrical body, and by the bottom end 5a of each drawing tool 5 resting in sliding manner on the cylindrical lateral surface of lifting wedge 22.

[0027] The Figure 7 variation differs from that in Figure 4 by lifting device 7 comprising, as opposed to two hydraulic actuators 8, a substantially V-shaped rocker arm 25 positioned with the central portion resting on the bottom of seat 21, and with each of the two ends resting against the bottom end 5a of a respective drawing tool 5.

[0028] Operation of die 1 is easily deducible from the foregoing description with no further explanation required.

[0029] As at present, sheet 2 is drawn by positioning a portion of sheet 2 between die 1 and drawing punch 100, and moving drawing punch 100 from the parking to the work position. In this case, however, one of the two drawing tools 5 must be set to the extracted position, and the other to the withdrawn position. Obviously, the shape of drawing tools 5 depends on the type of deformation required of sheet 2.

[0030] Like appendix V of currently used dies, to enable sheet 2 to be ejected from die 1 and to be moved easily in work plane P, drawing tools 5 in the withdrawn or intermediate parking position must project from top surface 4a of main body 4 by a given length (zero or $h/2$ in the example shown) which, added to the drawing depth of sheet 2 (h in the example shown) must be less than or equal to distance d between the top surface 4a of main body 4 and the bottom end of drawing punch 100 in the parking position.

[0031] In the Figure 2 embodiment in which drawing tools 5 are normally in the withdrawn position, the relationship between height h and distance d is as follows: height h must be less than or equal to distance d according to the equation : $0 + h \leq d$.

[0032] In the embodiments in which drawing tools 5 are normally in the intermediate parking position, the relationship between height h and distance d is as follows : height h must be less than or equal to two thirds of dis-

tance d according to the equation : $h/2 + h \leq d$. In this case, in the intermediate parking position, drawing tools 5 project from top surface 4a of main body 4 by a length less than or equal to $d/3$.

[0033] The advantages of die 1 are self-evident. In the extracted position, drawing tool 5 projects above work plane P by an end portion of length h greater than the distance $d/2$ constituting the current construction limit. Moreover, in the intermediate parking position, drawing tools 5 project above work plane P by respective end portions of length $d/3$, thus enabling easier handling of sheets 2 in work plane P. Yet another advantage of die 1 is that of now housing two drawing tools 5.

[0034] Clearly, changes may be made to die 1 for drawing sheet metal and similar as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. A die (1) for drawing sheet metal (2) and similar, the die comprising a main body (4) which may be housed inside any die holder seat (3) on a machine tool, with a top surface (4a) substantially coplanar with the work plane (P) of the sheet metal (2) to be worked; and at least a pair of drawing tools (5) housed inside the main body (4) and movable between a withdrawn position, in which the drawing tools are confined within said main body (4), and an extracted position, in which the drawing tools project outwards of said main body (4) by a respective end portion of given length h ; the die being characterized by comprising actuating means (7) for selectively moving either of the two drawing tools (5) between the extracted position and the withdrawn position.
2. A die as claimed in Claim 1, characterized in that said actuating means (7) provide for selectively moving said drawing tools (5) oppositely with respect to each other between the extracted position and the withdrawn position, so that both drawing tools (5) can never be simultaneously in the extracted position or the withdrawn position.
3. A die as claimed in Claim 2, characterized in that said actuating means (7) provide for selectively setting said two drawing tools (5) simultaneously to an intermediate parking position, in which both drawing tools (5) project outwards of the main body (4) by a respective end portion of length $h/2$.
4. A die as claimed in any one of the foregoing Claims, characterized in that said drawing tools (5) are mounted in axially-sliding manner inside at least one seat (6, 21) extending inwards of the main body (4) from the top surface (4a) of the main body (4).
5. A die as claimed in any one of the foregoing Claims, characterized in that said actuating means (7) comprise elastic means (9) for maintaining said drawing tools (5) in the withdrawn position; and lifting means (8, 13, 14, 15) (8, 20) (22, 23) (25) for selectively lifting either of said two drawing tools (5) into the extracted position.
6. A die as claimed in Claim 5, characterized in that said lifting means (8, 13, 14, 15) (8, 20) (22, 23) (25) comprise a pair of hydraulic actuators (8) located at the bottom of said at least one seat (6, 21); each said hydraulic actuator (8) being located beneath a respective drawing tool (5) and lifting the drawing tool (5) into the extracted position in opposition to said elastic means (9).
7. A die as claimed in Claim 6, characterized in that said lifting means (8, 13, 14, 15) (8, 20) (22, 23) (25) comprise a hydraulic control circuit (15) for controlling said hydraulic actuators (8); said hydraulic control circuit (15) being outside said main body (4); and the hydraulic actuators (8) being connected to said hydraulic control circuit (15) by two supply conduits (13, 14) extending inside said main body (4).
8. A die as claimed in Claim 6, characterized in that said lifting means (8, 13, 14, 15) (8, 20) (22, 23) (25) comprise a connecting conduit (20) for directly connecting the two hydraulic actuators (8).
9. A die as claimed in Claim 5, characterized in that said lifting means (8, 13, 14, 15) (8, 20) (22, 23) (25) comprise a lifting wedge (22) movable along the bottom of said at least one seat (21); and a linear actuator (23) for selectively moving said lifting wedge (22) to and from two distinct work positions, in each of which said lifting wedge (22) is positioned beneath a respective drawing tool (5) to lift the drawing tool into the extracted position.
10. A die as claimed in Claim 9, characterized in that said lifting wedge (22) is defined by a substantially triangular-section prismatic body, and is positioned with one of the three faces resting on the bottom of said at least one seat (21); the bottom end (5a) of each of said two drawing tools (5) being defined by a flat surface inclined with respect to the longitudinal axis (B) of the drawing tool (5), and resting in sliding manner on a respective free face of the lifting wedge (22).
11. A die as claimed in Claim 9, characterized in that said lifting wedge (22) is defined by a cylindrical body; the bottom end (5a) of each of said two drawing tools (5) being defined by a flat surface inclined with respect to the longitudinal axis (B) of the drawing tool (5), and resting in sliding manner on the cy-

lindrical lateral surface of the lifting wedge (22).

12. A die as claimed in Claim 5, characterized in that said lifting means (8,13,14,15) (8,20) (22,23) (25) comprise a substantially V-shaped rocker arm (25) positioned with the central portion resting on the bottom of said at least one seat (21), and with each of the two ends resting against the bottom end (5a) of a respective drawing tool (5).

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PRIOR ART

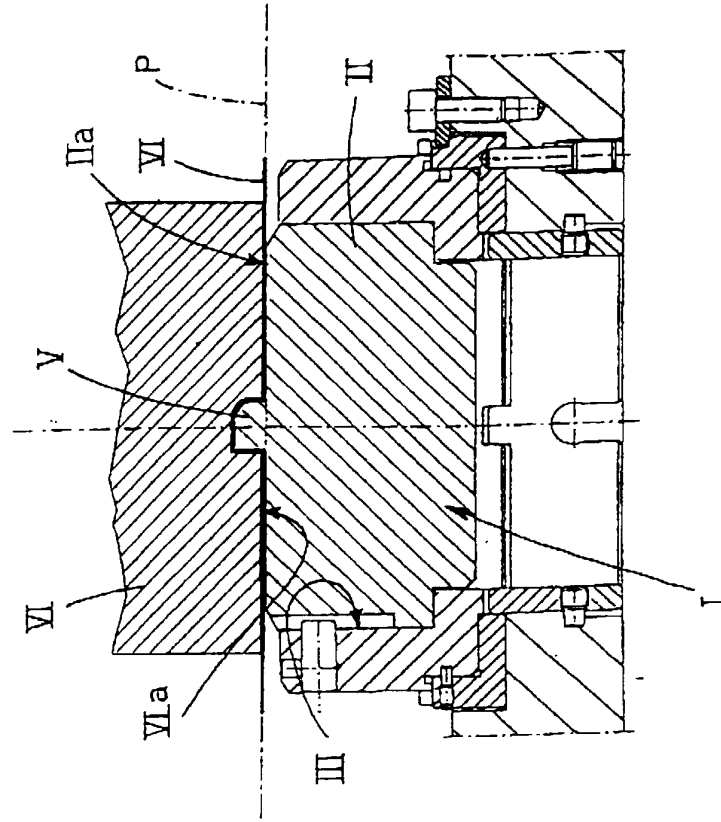


Fig.1b

PRIOR ART

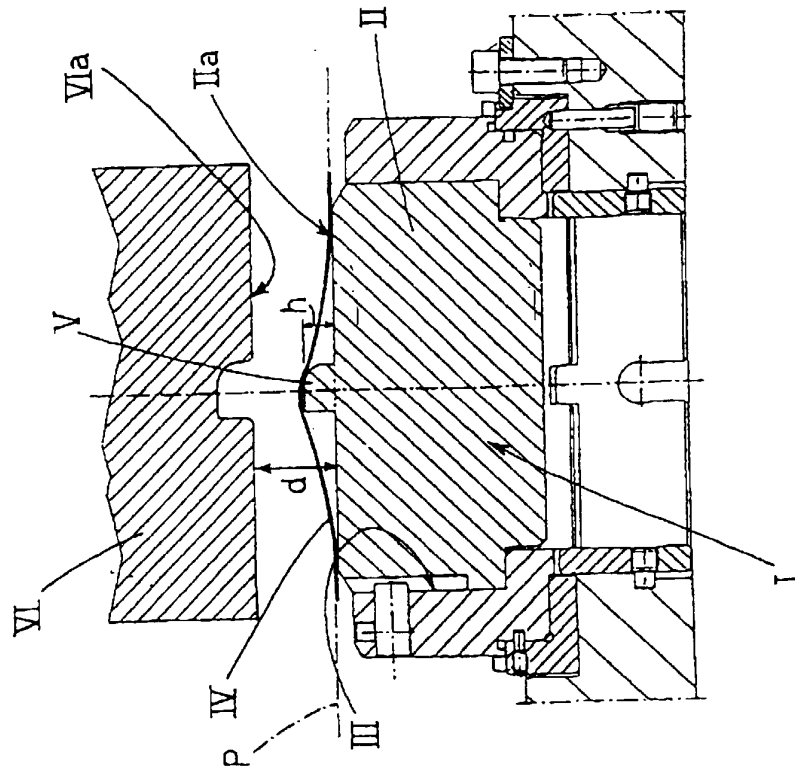


Fig.1a

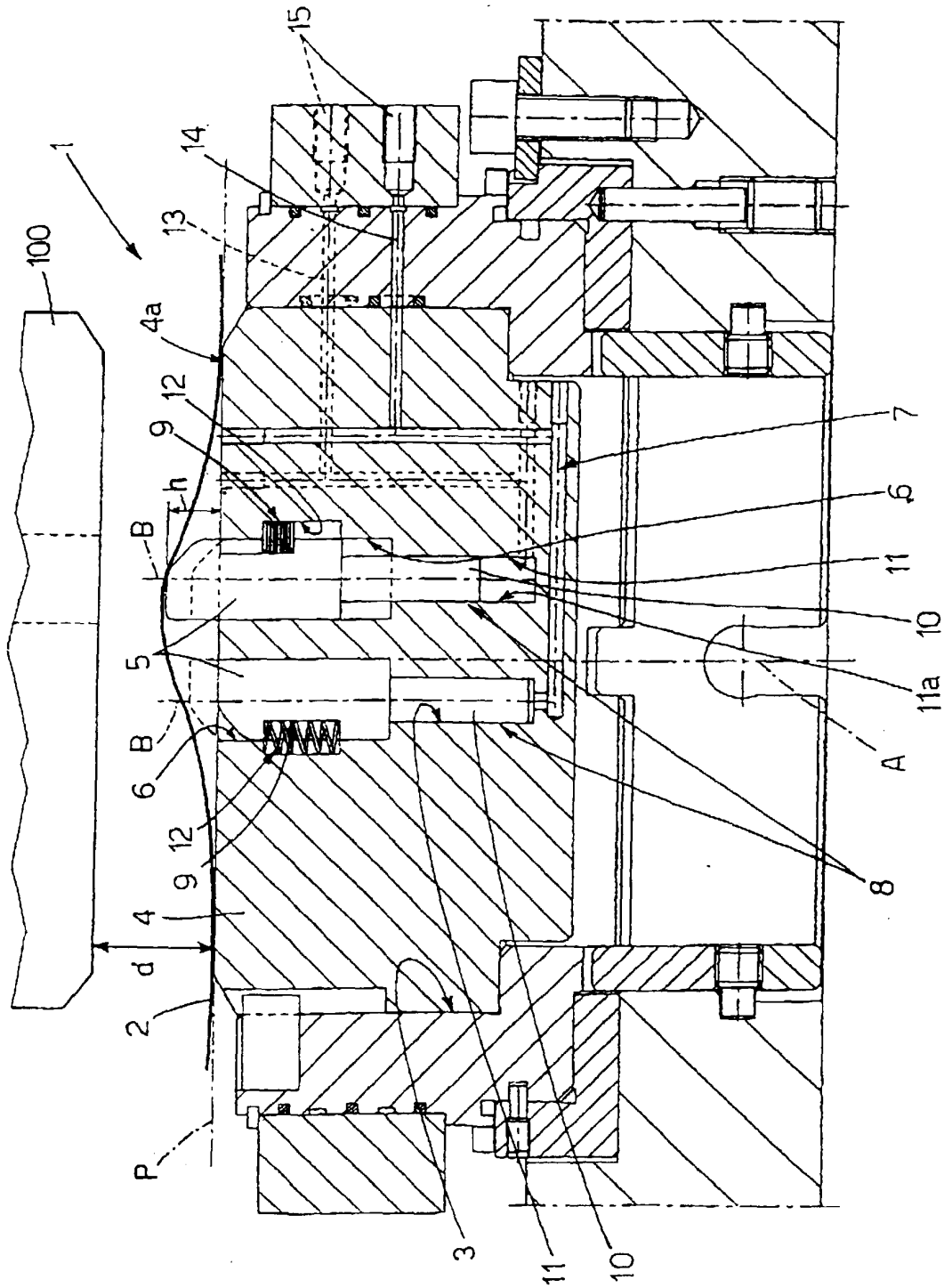


Fig. 2

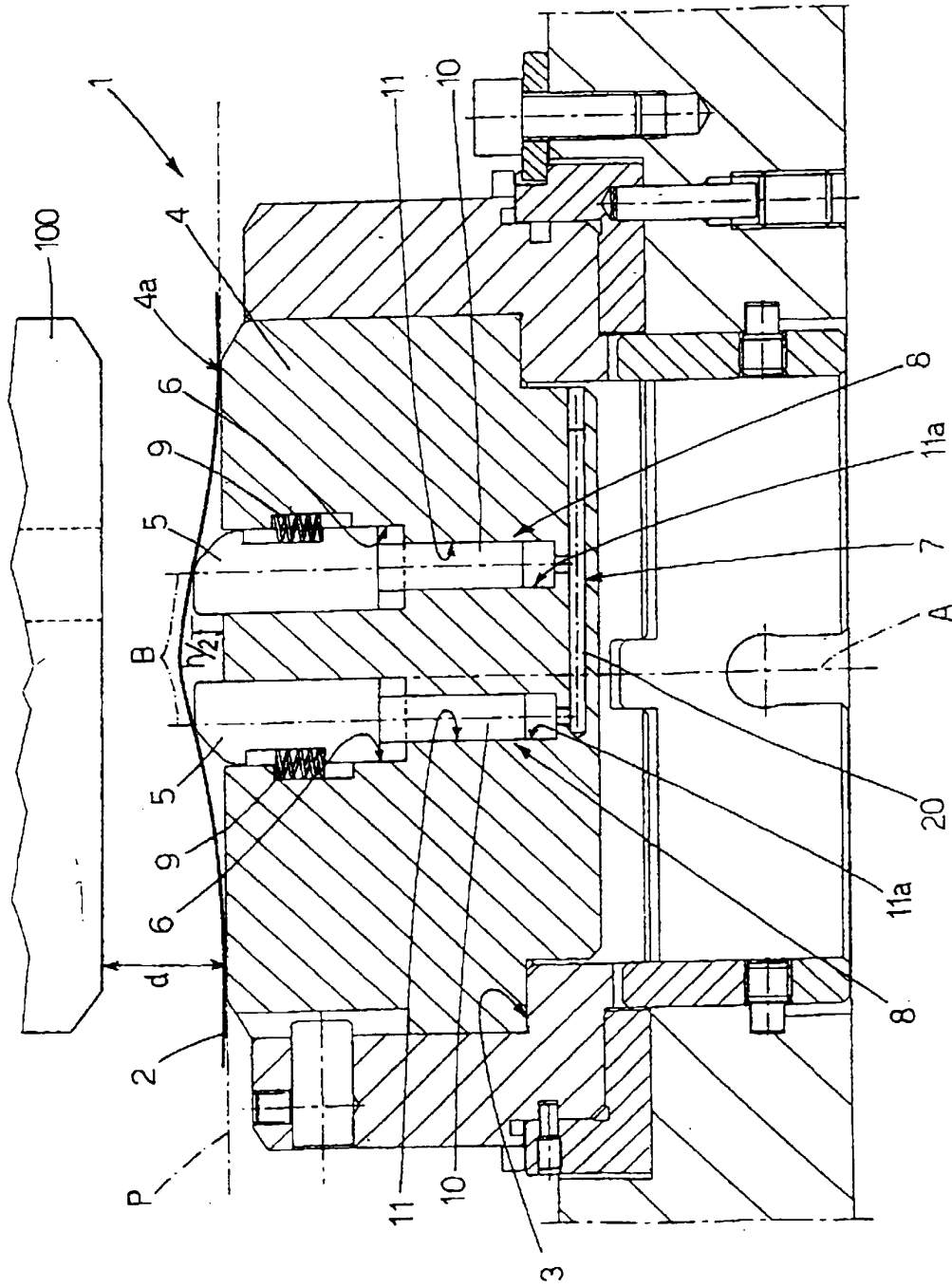


Fig. 3

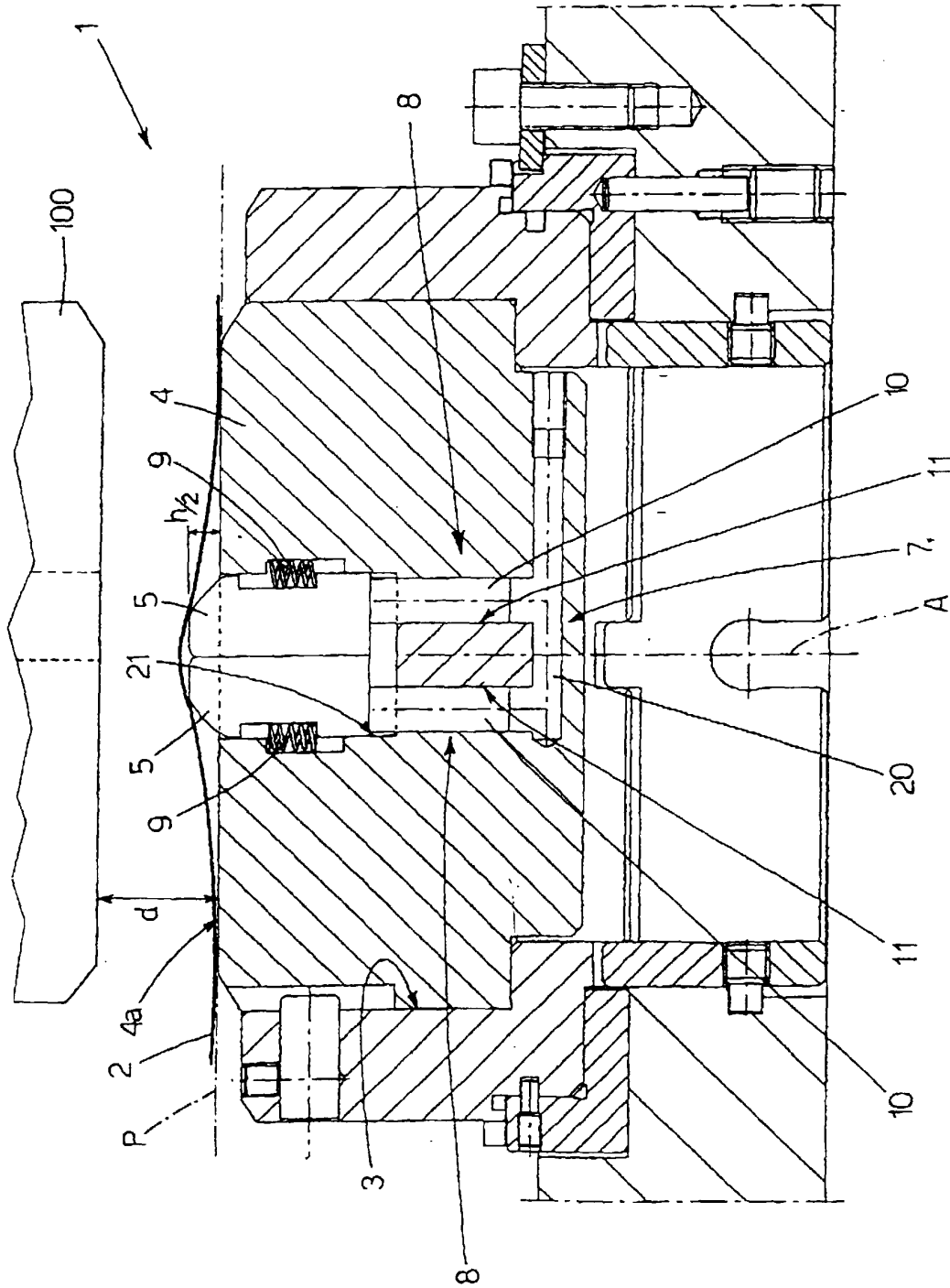


Fig. 4

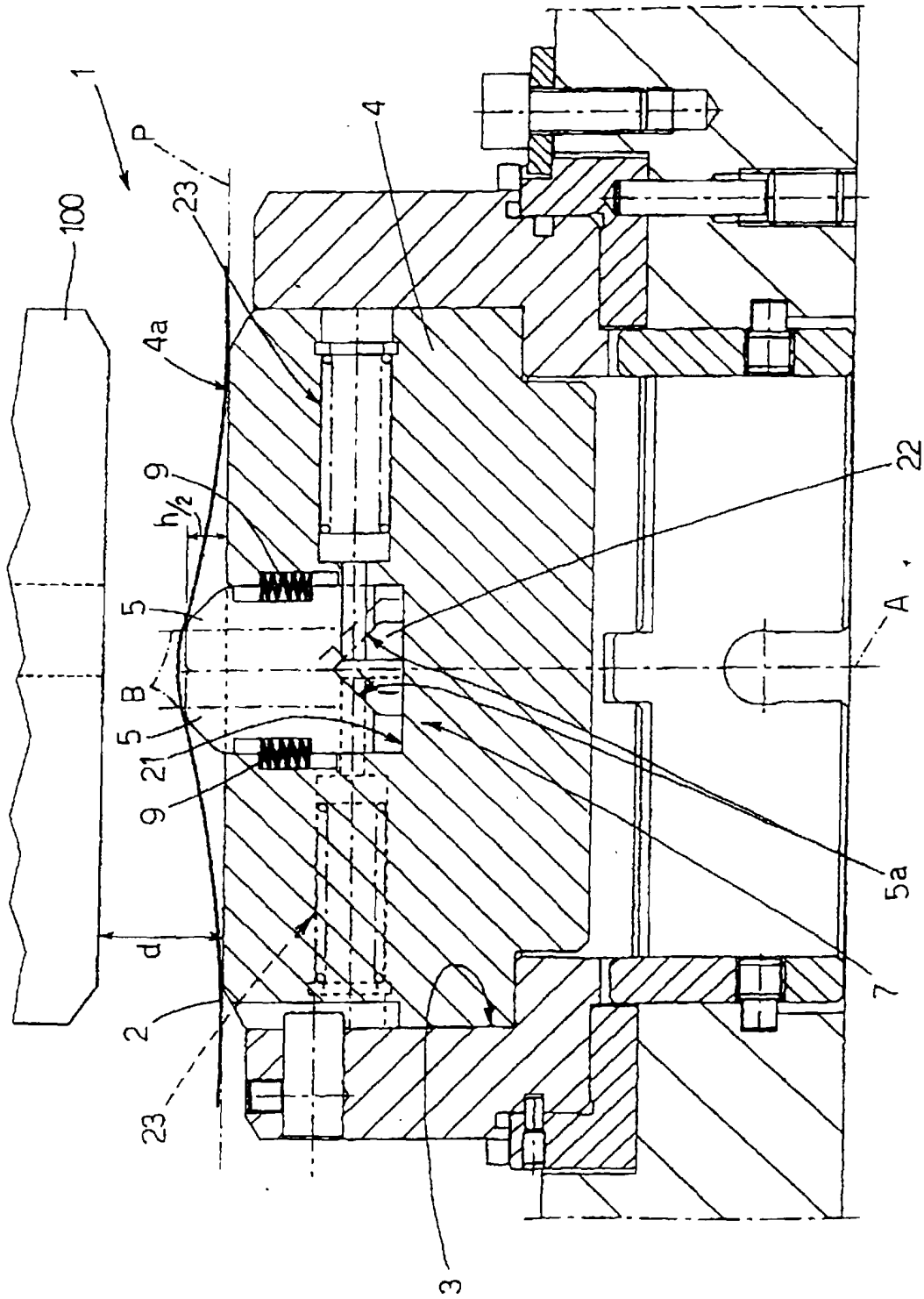
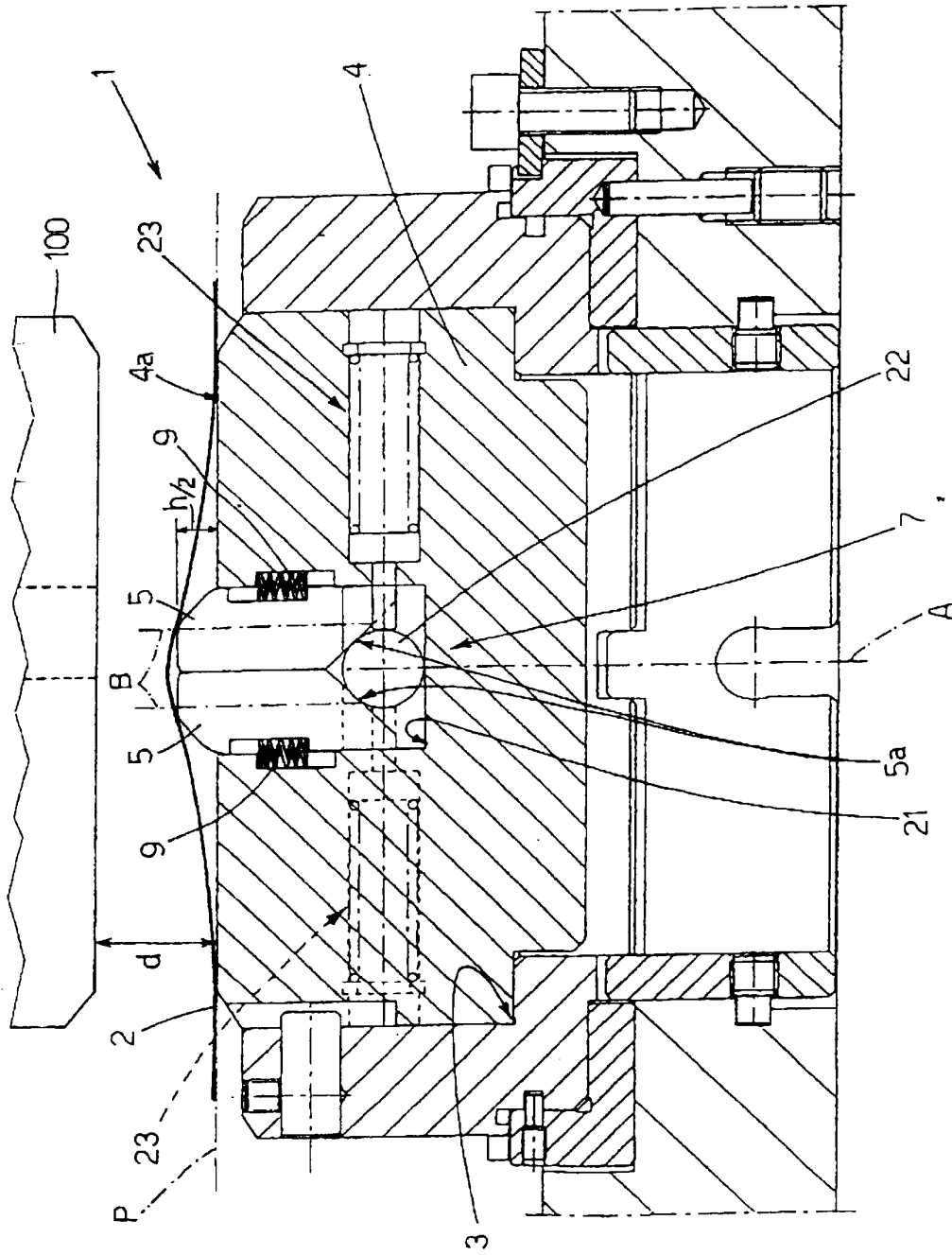


Fig. 5



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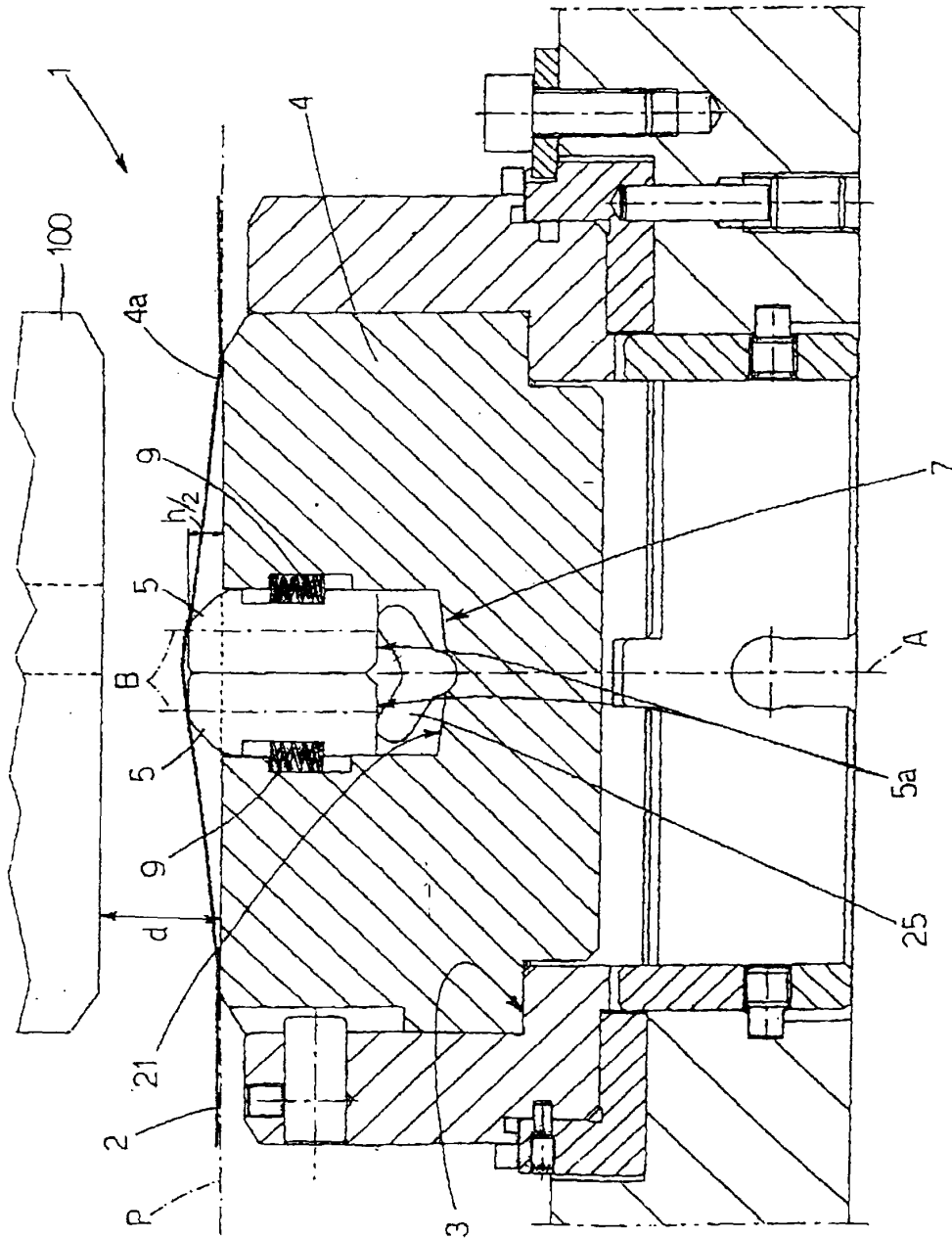


Fig.7



European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 99 83 0200

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	DE 11 34 956 B (HUET) * the whole document *	1	B21D22/02
A	PATENT ABSTRACTS OF JAPAN vol. 006, no. 142 (M-146), 31 July 1982 (1982-07-31) & JP 57 064498 A (TOYOTA MOTOR CORP), 19 April 1982 (1982-04-19) * abstract *	1	
A	GB 525 075 A (GLASNER) * page 5; figures 2,3 *	1	
A	US 3 650 142 A (BALDWIN WILLIAM M JR ET AL) 21 March 1972 (1972-03-21) * column 8, paragraph 2 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			B21D
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		14 October 1999	Gerard, O
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 99 83 0200

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-10-1999

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